

- 1) A process for selectively reacting polyene compounds in a hydrocarbon fuel stream,
comprising the steps of:
contacting the polyene compounds with sulfuric acid, in an amount such that the sulfuric
acid is from about 0.5 to about 10 vol % of the hydrocarbon stream to convert the polyene
5 compounds to organic sulfate compounds, forming a first hydrocarbon phase and a spent
acid phase;
oxidizing the sulfur in the hydrocarbon phase by contacting the hydrocarbon phase with a
sufficient quantity of an oxidant to form a second hydrocarbon phase which will
substantially retain the octane or cetane number of the original hydrocarbon stream with
10 substantially no loss in octane or cetane number and a spent oxidant phase; and
recovering as a fuel product the second hydrocarbon phase from the spent oxidant phase,
wherein the strength of the sulfuric acid is from about 80 wt% to about 98 wt%.
- 2) The process of claim 1, wherein the sulfuric acid is in an amount of from about 1 vol% to
about 4 vol % of the hydrocarbon stream.
- 15 3) The process of claim 1, wherein the strength of the sulfuric acid is from about 89 wt% to
about 93 wt%.
- 4) The process of claim 1, wherein the hydrocarbon stream also includes organic sulfur
compounds, the process further comprising the steps of:
contacting the first hydrocarbon phase with an aqueous oxidizing solution comprising
20 hydrogen peroxide, and formic acid in a mole ratio of at least about 11:1 formic acid to
hydrogen peroxide and having less than about 25 wt % water, in an amount such that the
hydrogen peroxide present is greater than about two times the stoichiometric amount
required to convert at least part of the original sulfur in the feed to corresponding
sulfones, at a temperature of from about 50 °C to about 130 °C to form a second

- hydrocarbon phase from which sulfur has been removed and an aqueous phase containing oxidized sulfur extracted from the first hydrocarbon phase;
- separating the aqueous phase containing the extracted sulfur compounds from the second hydrocarbon phase;
- 5 recovering the second hydrocarbon phase as a fuel having reduced sulfur content;
- flashing the aqueous phase to separate the formic acid and water from the oxidized sulfur compounds;
- distilling the aqueous phase to remove water from the formic acid; and
- recovering the formic acid.
- 10 5) The process of claim 4 wherein the formic acid is present in the oxidizing solution in an amount of from about 75 wt % to about 92 wt %, and the hydrogen peroxide is present in an amount of from about 0.5% to about 4 wt %.
- 6) The process of claim 4 wherein the amount of the oxidizing solution added is sufficient to provide a stoichiometric excess of from about 2 to about 8 times the amount required to
- 15 oxidize the sulfur present.
- 7) The process of claim 4 further comprising neutralizing any residual acid and dehydrating the second hydrocarbon phase to produce a neutral dehydrated product.
- 8) The process of claim 7 wherein neutralizing comprises the steps of:
- treating the recovered second hydrocarbon phase with a sufficient quantity of calcium
- 20 oxide;
- and separating the neutralized fuel from the calcium oxide.
- 9) The process of claim 7 wherein neutralizing comprises water washing the hydrocarbon phase and contacting with a salt dehydrator to produce the neutral dehydrated product.

- 10) The process of claim 10 wherein neutralizing comprises contacting the hydrocarbon phase with a sufficient amount of caustic.
- 11) The process of claim 1, wherein the spent acid phase may be recycled to the process by adding small incremental amounts of fresh acid to maintain the strength and amount of acid.
- 12) The process of claim 4, further comprising passing the first hydrocarbon phase through a coalescer ;
water washing the first hydrocarbon phase to remove sulfates; and
drying the hydrocarbon phase.
- 13) In a process for removing sulfur compounds from hydrocarbon fuels, comprising the steps of:
contacting the sulfur containing fuel with an aqueous oxidizing solution to form a hydrocarbon fuel phase from which sulfur has been removed and an aqueous phase containing oxidized sulfur extracted from the hydrocarbon fuel phase;
separating the aqueous phase containing the extracted sulfur compounds from the hydrocarbon fuel phase; and
recovering the hydrocarbon phase containing the fuel having reduced sulfur content;
the improvement comprising the steps of: pre-treating the sulfur containing fuel, before oxidation of sulfur compounds, by contacting the fuel with sulfuric acid having a strength of from about 80 wt% to about 98 wt% in an amount of from about 0.5 to about 10 vol % based upon the amount of sulfur containing fuel to convert polyene compounds in the sulfur containing fuel to organic sulfate compounds, to form an aqueous acid phase and a hydrocarbon phase with substantially no loss in octane or cetane number; and
separating the hydrocarbon phase from the spent acid phase.

- 14) The process of claim 13, wherein the aqueous oxidizing solution comprises hydrogen peroxide and formic acid in a mole ratio of at least about 11:1 formic acid to hydrogen peroxide and having less than about 25 wt % water, in an amount such that the hydrogen peroxide present is greater than about two times the stoichiometric amount required to convert the sulfur compounds present to corresponding sulfones, at a temperature of from about 50 °C to about 130 °C.
- 15) The process of claim 1, wherein the sulfuric acid is a spent sulfuric acid stream from a refinery alkylation process.
- 16) The process of claim 1, wherein contacting occurs at temperatures of from about 0 °C to about 60 °C and at pressures of from about 10 to about 50 psi.
- 17) The process of claim 2, wherein the sulfuric acid is in an amount of from about 2 vol% to about 3 vol % of the hydrocarbon stream.
- 18) The process of claim 3, wherein the strength of the sulfuric acid is about 93 wt%.
- 19) The process of claim 1, wherein the reaction residence time for converting the polyene compounds to organic sulfate compounds is less than about 5 minutes.